APPENDIX A

FIELD SAMPLING PLAN

OPERABLE UNIT 1

QUANTA RESOURCES SITE
EDGEWATER, NEW JERSEY

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SECTION 1
INTRODUCTION AND SAMPLING SUMMARY

1.1 INTRODUCTION

This Field Sampling Plan (FSP) describes in detail the sampling and data gathering methods and procedures to be used during the remedial investigation/feasibility study (RI/FS) field activities at the Quanta Resources Site (the Site) Operational Unit 1 (OU1). A detailed description of the Site, the history and background, and a description of the site-related contamination are provided in Section 1 of the RI/FS Work Plan, to which this FSP is an appendix. This FSP should be used in conjunction with the Quality Assurance Project Plan (QAPP) (Appendix B) to guide all field and laboratory sampling and measurement conducted as part of the RI. Together, the FSP and the QAPP comprise the Sampling and Analysis Plan (SAP) under the CERCLA RI/FS process.

1.2 SAMPLING OBJECTIVES

The main objective of the field sampling is to determine the physical and chemical conditions at the site and their possible impact and risks posed to human health and the environment. In particular, the specific objectives of the RI, as described in the work plan are:

- Characterize potential soil and ground water impacts associated with operations at the Quanta property.
- Define the nature and extent of contamination. Delineate contamination in ground water and soil.
- Evaluate the potential for human health and ecological impacts associated with operations at the Quanta property.
- Develop sufficient data to determine the need for and to allow a screening of appropriate remedial alternatives, recommendation of the most appropriate remedial alternative, and the development of a conceptual plan.

1.3 SAMPLE LOCATIONS, INVESTIGATIONS, AND FREQUENCY

Field sampling activities to be conducted in support of the RI for OU1 are described in the following subsections. The sampling objectives and intended data uses are described on Table 1-1 of this FSP. The number of field samples, QA/QC samples, the analytical parameters, and the analytical methods are summarized on Table 1-2. See Sections 3, 4, 5, and 6 of this FSP for investigation methods. The locations of sample investigation points are shown on Figure 5-1 in the Work Plan.

1.3.1 OU1

Soil Borings/Soil Samples

Soil borings will be drilled using hollow stem augers and split-spoon samplers to a predetermined depth as indicated on Table 5-1 in the Work Plan. Proposed soil boring and monitoring well locations are shown on Figure 5-1 in the Work Plan. The soil borings will be continuously sampled for visual soil description and screened with a photoionization detector (PID). See Section 6 of the Work Plan for a detailed description of the soil boring and soil sampling tasks.

Monitoring Well Soil Borings/Well Construction

Monitoring wells will be installed at the locations shown on Figure 5-1 of the Work Plan. The well borings will be drilled from the ground surface to varying depths (to the water table, at the top of the silt/clay unit, and installed in the deep sand). The well borings will be sampled as described in the Work Plan. The monitoring well construction is described in the Work Plan and in Section 6. The sample locations are summarized on Table 5-1 in the Work Plan.

Groundwater and NAPL Sampling

Groundwater samples will be collected from each of the new and existing monitoring wells at the Quanta Site. Ground water will be analyzed for VOCs, SVOCs, PCBs, Pesticides, arsenic, lead, and ammonia in accordance with Table 5-1 in the Work Plan. Field parameters will be measured and recorded during purging. Quarterly ground water sampling will be conducted for one year.

Select LNAPL and DNAPL samples will be collected for fingerprint, PCB analyses, and as described on Table 1-2, depending on the mapped distribution. If free product is found in any of the monitoring wells, an interim remedial measure to bail and properly dispose of NAPL on a periodic basis may be implemented.

NAPL and Water Level Measurements

Synoptic water levels will be measured in all available wells (temporary and permanent) to reflect the seasonal variation in water table conditions. The measurements will be used to construct groundwater contour maps and evaluate vertical gradients. LNAPL and DNAPL measurements will be made at the same time.

In-situ Hydraulic Conductivity Tests

In situ permeability tests will be conducted on shallow monitoring wells and on the proposed deep sand wells. The *in situ* permeability tests will consist of a rising head slug test for shallow wells, and either a rising or falling head slug test may be used in the deep wells if the screen is fully submerged.

Tidal Study for Mean Hydraulic Gradient

The study will coincide with the monitoring well program and will include measurements in permanent monitoring and a tidal gauging station. Hourly groundwater level data will be collected in wells and in surface water gauging stations. The data will be used to determine the average groundwater gradient.

As part of the tidal study at the Quanta Site, a tidal gauging station (TGS-1) will be installed on and secured to the Spencer Kellogg Pier beyond the low tide line.

Subsurface Utility Field Survey

The survey will use as-built drawings and visual observation to locate and identify potential conduits for contamination migration on and off-site. The observations of the subsurface utility field survey will be used to identify locations that may need additional investigation.

Building Survey for Potential Impacts to Indoor Air Quality

A building survey and indoor air investigation will be undertaken at the commercial building located at 115 River Road to address potential impacts to indoor air quality. The investigation will be performed by 115 River Road, LLC using Environmental Waste Management Associates, LLC (EWMA) in order to better control the access and coordination with tenants.

A detailed work plan has been developed by EWMA for this work and it is included as Attachment A to this Work Plan. The general components of the work plan are documented in this RI/FS Work Plan for OU1; however, it should be noted that the indoor air investigation is being conducted independently by EWMA for 115 River Road, LLC. The work product and data generated from the EWMA investigation will be evaluated by Honeywell, QSAG and USEPA to determine if it is acceptable for use in the risk assessment portion of the Quanta RI. It is recognized that USEPA reserves the right to reject the data if it is not acceptable.

The scope of work for the vapor intrusion investigation was developed by EWMA and it is based on the guidance in the November 2002 document "*Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils*" issued by USEPA Office of Solid Waste and Emergency Response (OSWER). In addition, the existing interim "*Vapor Intrusion Pathway – Indoor Air Guidance*" issued by New Jersey Department of Environmental Protection (NJDEP) was used as a reference.

TABLES

Table 1-1
Sampling Objectives and Data Uses
Quanta Resources Site
Edgewater, New Jersey

Sampling/Monitoring Activity	Objective	Intended Data Usage
Soil Borings	Drill 36 soil borings to facilitate soil sampling.	Data will be used during the RI evaluation to assess the potential soil impacts from the former operations, and to refine the stratigraphy on the Site.
Permanent Monitoring Well Installations	Install 33 permanent monitoring wells to facilitate ground water sampling and aquifer testing.	Data will be used to assess potential ground water impacts at OU1 and to assess aquifer conditions.
Soil Sampling	Collect samples from borings and during installation of permanent wells to characterize the vertical and horizontal extent of contamination at Site.	Data will be used to assess the potential impacts to site soils. The data will also be used for risk assessment.
Ground Water Sampling	Collect 51 ground water samples from new and existing monitoring wells.	Assess ground water conditions at the Site in OU1. Also, wells near the surface water (bulkhead) will be used to calculate concentrations COCs in surface water. The data will also be used for the risk assessment.
NAPL Sampling	Collect NAPL samples from monitoring wells	Characterize the properties of the NAPL.

Table 1-1 (Cont.)
Sampling Objectives and Data Uses
Quanta Resources Site
Edgewater, New Jersey

Sampling/Monitoring Activity	Objective	Intended Data Usage
In situ Permeability Tests	Conduct 14 *in situ* permeability tests to determine the hydraulic conductivity of the water bearing zones at the former site.	The hydraulic conductivity data will be used in the assessment of ground water at the Site and in evaluating remedial alternatives for ground water. Will also be used to calculate the potential flux into the surface water and the concentrations of COCs in the surface water.
Tidal Study	Install transducers and data loggers to collect groundwater elevation data over a 72-hour period.	To determine the magnitude and extent of tidal influence on the water table groundwater zone and to determine mean hydraulic gradient.
Building Survey	Survey building using field analytical methods and other available data.	To assess the potential for indoor air impacts and the need for indoor air sampling.
Instrument Survey	Locate and obtain vertical and horizontal survey of all sampling locations and all existing monitoring wells.	To accurately locate sample locations.
Underground Utility Field Survey	To identify, in the field, possible conduits for contamination on and off site.	To be able to identify areas that may need additional investigation.

Table 1-2
Summary of Samples and Analyses
Quanta Resources Site
Edgewater, New Jersey

Sample Description	Sample Depth	# of Samples	Parameter	Analytical Method	QA/QC Samples
<u>**Soil**</u>					
Surface and Subsurface Samples *(Chemical)*	0-6" At water table Determined in field 2 ft into the clay silt	148	VOC	CLP–OLM04.3	Field Blank (per SDG) Duplicates (7) MS/MSD (7)
		148	SVOC	CLP-OLM04.3	Field Blank (per SDG) Duplicates (7) MS/MSD (7)
		148	PCB	CLP-OLM04.3	Field Blank (per SDG) Duplicates (7) MS/MSD (7)
		24	Pesticides	CLP-OLM04.3	Field Blank (per SDG) Duplicates (1) MS/MSD (1)
		128	Arsenic and Lead	CLP-ILM05.2	Field Blank (per SDG) Duplicates (6) MS/MSD (6)
		35**	Total Chromium	CLP-ILM05.2	Field Blank (per SDG) Duplicates (2) MS/MSD (2)

Table 1-2 (Cont.)
Summary of Samples and Analyses
Quanta Resources Site
Edgewater, New Jersey

Sample Description	Sample Depth	# of Samples	Parameter	Analytical Method	QA/QC Samples
Surface and Subsurface Samples *(Chemical)*	0-6" At water table Determined in field 2 ft into the clay silt	148	Hexavalent Chromium	SW-846 Method 7196A or 7199	Field Blank (per SDG) Duplicates (7) MS/MSD (7)
		20	TAL Metals	CLP-ILM05.2	Field Blank (per SDG) Duplicates (1) MS/MSD (1)
		28	Ammonia	350.1	Field Blank (per SDG) Duplicates (1) MS/MSD (1)
Subsurface Samples *(Geotechnical)*	At water table	36	Grain Size*	ASTM D422	NA
	Upper portion of Clay/Silt layer	6	Atterberg Limits (along bulkhead only)	ASTM D4318	NA
Quarterly Sampling (1 year) Ground water samples from site wells.	Screened Interval	51	VOC	CLP–OLM04.3	Field Blank (per SDG) Trip Blank (per SDG) Duplicates (2) MS/MSD (2)

Table 1-2 (Cont.)
Summary of Samples and Analyses
Quanta Resources Site
Edgewater, New Jersey

Sample Description	Sample Depth	# of Samples	Parameter	Analytical Method	QA/QC Samples
Quarterly Sampling (1 year) Ground water samples from site wells.	Screened Interval	51	SVOC	CLP–OLM04.3	Field Blank (per SDG) Duplicates (2) MS/MSD (2)
		51	PCB	CLP–OLM04.3	Field Blank (per SDG) Duplicates (2) MS/MSD (2)
Quarterly Sampling (1 year) Ground water samples from site wells.	Screened Interval	11	Pesticides	CLP–OLM04.3	Field Blank (per SDG) Duplicates (1) MS/MSD (1)
		51	Arsenic and Lead	CLP-ILM05.2	Field Blank (per SDG) Duplicates (2) MS/MSD (2)
		7	Ammonia	350.1	Field Blank (per SDG) Duplicates (2) MS/MSD (2)

Table 1-2 (Cont.)
Summary of Samples and Analyses
Quanta Resources Site
Edgewater, New Jersey

Sample Description	Sample Depth	# of Samples	Parameter	Analytical Method	QA/QC Samples
Additional Sampling Estimated ground water samples from site wells.	Screened Interval	TBD Honeywell and EPA will evaluate all quarterly data to determine what wells and what analyses need to be sampled.	TBD	TBD	TBD
Free Product (LNAPL and DNAPL)	Top of water table, and bottom of well).	TBD	Fingerprinting PCBs Density Specific gravity Viscosity Interfacial Tension Surface Tension	EPA Method 8015 EPA Method 8082 ASTM D1298-85 ASTM 1429 ASTM D445/6 ASTM D971 ASTM D3825-90	TBD

*If required, depending on soil type determined by particle size analysis, ASTM D422.
**One Total Chromium sample from the unsaturated zone and one Total Chromium from selected deep sand samples will be analyzed for each location.

SECTION 2
GENERAL GUIDELINES FOR FIELD WORK

2.1 SURFACE HAZARDS

Potential on-site surface hazards, such as sharp objects, overhead power lines, and building hazards, will be identified prior to initiation of fieldwork. Generally, such hazards will be identified during a site reconnaissance visit that precedes fieldwork.

2.2 UNDERGROUND UTILITIES

All underground utilities, including electric lines, gas lines, and communication lines, will be identified prior to initiation of drilling and other subsurface work. This will be accomplished by contacting New Jersey One Call (One Call): (800) 272-1000. A One Call representative(s) will mark all buried utility lines in the work area. New Jersey State law requires that One Call be notified at least 3 working days, and not more than 10 working days, before subsurface work is conducted. In addition, site representatives for Honeywell will be contacted to identify any other facility utilities, sewer lines, or other obstructions that may pose a risk to health and safety. In addition, applicable portions of Parsons Pre-drilling Protocol will be followed.

2.3 FIELD LOG BOOKS

All field activities will be carefully documented in field logbooks. Entries will be of sufficient detail that a complete daily record of significant events, observations, and measurements is obtained. The field books will provide a legal record of the activities conducted at the site. Accordingly:

- Field books will be assigned a unique identification number;
- Field books will be bound with consecutively numbered pages;
- Field books will be controlled by the Field Team Leader while field work is in progress;
- Entries will be written with waterproof ink;
- Entries will be signed and dated at the conclusion of each day of field work;
- Erroneous entries made while fieldwork is in progress will be corrected by the person that made the entries. Corrections will be made by drawing a line through the error, entering the correct information, and initialing the correction;
- Corrections made after departing the field will be made by the person who made the original entries. The correction will be made by drawing a line through the error, entering the correct information, and initialing and dating the time of the correction; and
- The Parsons Project Manager will control field books when fieldwork is not in progress.

At a minimum, daily field book entries will include the following information:

- Date and page number on each page or set of pages;

- Location of field activity;
- Date and time of entry;
- Names and titles of field team members;
- Names and titles of any site visitors and site contacts;
- Weather information: temperature, cloud coverage, wind speed and direction;
- Purpose of field activity;
- A detailed description of the fieldwork conducted, observations and any measurements or readings. Where appropriate, a hand-drawn sketch map will also be included that identifies significant landmarks, features, sample locations, and utilities; and.
- When appropriate, boring numbers, well numbers, sample point ID or key activities should be identified on the top of each page to facilitate retrieval of data at a later date.

2.4 PERMITS

Prior to commencing fieldwork, all applicable permits will be obtained. This includes obtaining permits from the New Jersey Bureau of Water Allocation for soil borings greater than 50 feet and all monitoring wells. In addition, completed well records and abandonment forms will be submitted to the Bureau of Water Allocation upon completion of well installation.

Permits from municipal authorities and other government agencies will also be obtained for drilling on public property. In addition, access agreements shall be obtained prior to working on surrounding properties.

SECTION 3
SAMPLING EQUIPMENT AND PROCEDURES FOR FIELD EQUIPMENT DECONTAMINATION, WASTE MANAGEMENT, AND EQUIPMENT CALIBRATION

3.1 FIELD EQUIPMENT CHECKLIST

A general list of equipment necessary for field measurement and sample collection includes:

- Appropriate sample containers (see QAPP);
- Chain-of-Custody seals and record forms;
- Field sample record forms;
- Log book and indelible ink markers;
- Phosphate-free decontamination detergent (such as Alconox), reagent-grade solvents, and deionized water to be used for decontaminating equipment between sampling stations;
- Buckets, plastic wash basins, plastic drop cloths, and scrub brushes to be used for decontaminating equipment;
- Camera and film for use in documenting sampling procedures and sample locations;
- Stakes to identify sampling locations;
- Shipping labels and forms;
- Knife;
- Bubble wrap or other packing/shipping material for sample bottles;
- Strapping tape;
- Clear plastic tape;
- Coolers;
- Duct tape;
- Rope;
- Re-sealable plastic bags;
- Portable field instruments (photoionization detector, metal detector, combustible gas indicator, conductivity meter, pH/temperature/conductivity meter, dissolved oxygen meter, redox probe, electronic water level indicator, etc.);
- Sampling equipment, such as bailers and scoops;
- Sampling gloves; and
- Health and safety equipment (see HSP).

3.2 EQUIPMENT DECONTAMINATION

3.2.1 Decontamination Pad for Drilling Equipment or other Heavy Equipment

A temporary decontamination pad will be constructed of high density polyethylene sheeting on a prepared surface sloped to a sump. The sump will also be lined and provide sufficient quantity to contain the decontamination water (i.e., steam cleaning condensate). Sides of the pad will be bermed so that all decontamination water is contained. The decontamination water will be pumped from the sump into 55-gallon drums. The location of the decontamination pad will be determined in the field.

3.2.2 Drilling Equipment Decontamination

All drilling equipment including drill rigs, augers, bits, rods, tools, split-spoon samplers, and tremie pipe will be cleaned with a high-pressure steam-cleaning unit, and scrubbed with a wire brush to remove dirt, grease, and oil before beginning work. Tools, drill rods, and augers will be placed on sawhorses or polyethylene plastic sheets following steam cleaning. Direct contact with the ground will be prevented. All augers, rods, and drilling tools will be decontaminated at the conclusion of drilling each boring.

3.2.3 Well Materials Decontamination

Monitoring well casing and screens will be decontaminated by the procedures described in Subsection 3.2.2 before installation. The screen and casing will be wrapped in polyethylene plastic following decontamination, and transported from the designated decontamination area to the well location. If the PVC well casings and screens are in factory sealed plastic sleeves, field decontamination will not be necessary.

3.2.4 Sampling Equipment Decontamination

<u>Soil Sampling Equipment</u>

Decontamination of non-dedicated and non-disposable sampling equipment will be conducted in a decontamination pad when one is readily available, otherwise decontamination will be conducted in buckets on plastic sheeting. Prior to sampling, all bowls, spoons, augers, Geoprobe® rods, and Macrocore® samplers (usually Dedicated) will be washed in potable water and phosphate-free detergent (e.g. Alconox). The sampling equipment will then be rinsed with potable water followed by a distilled water rinse. Between rinses, equipment will be placed on polyethylene sheets or aluminum foil if necessary. Sample equipment may also be steam cleaned, if appropriate. Sampling equipment will undergo either a solvent rinse (for volatiles) or an acid rinse (for metals). Sampling equipment will be wrapped in aluminum foil for storage or transportation from the designated decontamination area to the sample locations. Decontaminated equipment will not be placed directly on the ground surface. In order to minimize the time spent in the field and reduce the opportunity for cross contamination, the sampling team will have sufficient clean equipment available to complete a sampling round without excessive delays.

Submersible Pump Decontamination

Low flow submersible sampling pumps will be decontaminated before use and between uses by submerging the pump and down-hole wiring in 8- to 10-gallon containers of potable water followed by an Alconox/water solution, followed by a second potable water rinse, followed by a distilled water rinse (1-2 gallons). The pump will be run for five minutes in each of the 4 decontamination stations. Pumps will undergo a solvent or acid rinse for VOCs and metals respectively.

3.3 MANAGEMENT OF INVESTIGATION DERIVED WASTE

3.3.1 Decontamination Fluids

All steam cleaning and decontamination fluids will be collected in 55-gallon drums or a plastic temporary holding tank and temporarily stored onsite. At the end of the field activities, a composite water sample will be collected and analyzed for parameters as required by the disposal facility. The water will then be transported offsite for proper treatment and disposal.

3.3.2 Drill Cutting Cores

Soil borings will be backfilled with bentonite pellets or cement bentonite slurry. Monitoring well soil boring cuttings and excess soil samples will be placed in drums and staged for proper disposal. Soils may be drummed separately according to soil type (i.e., fill, clay/silt, and sand). Based on soil sample results, the excess soil will be disposed of accordingly.

3.3.3 Development Purge and Pumping Water

Development and purge water will be containerized and stored on site. At the end of field activities if any water is containerized, a composite water sample will be collected and analyzed for parameters as required by the disposal facility. The water will then be transported offsite for proper treatment and disposal.

3.3.4 Personal Protective Equipment

All personal protective equipment (PPE) will be placed in garbage bags and disposed of as a solid waste.

3.4 FIELD INSTRUMENT CALIBRATION

All field screening and sampling instruments (e.g., temperature-conductivity-pH probes) that require calibration prior to operation will be calibrated daily in accordance with the manufacturer's instructions. All instrument calibrations will be documented in the project field book and in instrument calibration logs for the various pieces of equipment. Instrument operating manuals will be maintained on-site by the field team.

3.5 MAINTENANCE PROCEDURES

3.5.1 Non-Routine Maintenance Procedures

Field equipment will be inspected prior to initiation of fieldwork to determine whether or not it is operational. If it is not operational, it will be serviced or replaced. Batteries will be fully charged or fresh disposable batteries will be installed, as applicable.

3.5.2 Routine Maintenance Procedures and Schedules

Field equipment requiring preventive maintenance will be serviced in accordance with written procedures based on the manufacturer's instructions or recommendations. Maintenance will be performed in accordance with the schedule specified by the manufacturer, in order to minimize the downtime of the measurement system. Qualified personnel will perform maintenance work.

3.5.3 Spare Parts

A list of critical spare parts will be developed prior to the initiation of fieldwork. Field personnel will have ready access to critical spare parts in order to minimize downtime while fieldwork is in progress. In lieu of maintaining an inventory of spare parts, access to critical spare parts may be provided by firms capable of rapid repair or replacement. These firms must be identified prior to initiation of fieldwork.

3.5.4 Maintenance Records

Equipment maintenance logs will be maintained to document maintenance activities and schedules. All maintenance logs will be traceable to a specific piece of equipment. These records may be audited by the Quality Assurance Officer to verify compliance.

SECTION 4
SAMPLING EQUIPMENT AND PROCEDURES FOR FIELD MEASUREMENTS AND MONITORING

4.1 AIR MONITORING

Air monitoring will be conducted during all field activities with a Photovac MicroTip HL-2000 (or equivalent) photoionization detector (PID) equipped with a 10.6 electron volt (eV) lamp, and with a combustible gas meter. The Photovac MicroTip is capable of ionizing and detecting compounds with an ionization potential of less than 10.6 eV. The PID and combustible gas meter will be used to monitor for volatile organic compounds (VOCs), oxygen, lower explosive limit (LEL), and carbon monoxide in the breathing zone and in boreholes, and to screen samples for laboratory analysis.

<u>Method</u>

- The PID will be calibrated at the beginning and end of each day of use with a standard calibration gas of a concentration within the expected range of use. The calibration gas that is most often used has an approximate concentration of 100 ppm of isobutylene.
- The multi-gas meter will be calibrated at the beginning of each day in accordance with the manufacturer's specifications using the appropriate standards.
- If abnormal or erratic readings are observed, additional calibration will be required.
- All calibration data will be recorded in field notebooks and on calibration log sheets to be maintained on-site.
- The PID and multi-gas meter will be used to monitor the breathing zone and the borehole during drilling. Action levels are specified in the Health and Safety Plan (HSP).
- The PID will also be used to screen samples and sample headspace.
- Readings will be recorded in the field book and on the drilling record during drilling activities.
- A battery check will be completed at the beginning and end of each working day, and the battery will be checked for proper voltage.

4.2 WATER AND NAPL LEVEL MEASUREMENTS

Ground water and NAPL level measurements will be conducted at the Site. The following procedures will be used to measure static groundwater levels in monitoring wells, observation wells and piezometers:

- The cap on the monitoring well will be opened and the breathing zone above the opening of the casing will be screened for organic vapors with a PID.
- The static water level in each monitoring well, observation well or piezometer will be measured with a decontaminated electronic oil/water level indicator.

- The water level will be measured to the nearest 0.01 foot from the surveyed well elevation mark on the top of the casing.
- The total depth of the well will be measured.
- If indications of the presence of LNAPL are present, an interface probe will be used to gauge the thickness of LNAPL. LNAPL thickness may also be gauged by lowering a bailer gently through the LNAPL then slowly retrieving the bailer. The height of LNAPL will be measured inside the bailer. LNAPL observations should be recorded in the field notes.
- The interface probe will also be used to determine if DNAPL is present in the bottom of the well. DNAPL observations should be recorded in the field notes
- The well depth and water level measurement will be recorded in the field book and on the ground water/NAPL measurement form (Figure 4-1).

4.3 AQUIFER TESTING - SLUG TESTS

The following section specifies the methods that will be used to conduct aquifer slug tests.

Equipment and Supplies for Slug Tests

- Electronic data logger (Hermit Model SE 1000C or 2000 or equivalent) and either 5 or 10 psi transducers.
- Electronic water level indicator (Solinist or equivalent).
- Oil/water interface probe.
- Stainless Steel Slugs.
- Field Supplies (rope, duct tape).
- Personal protective equipment in accordance with the project Health and Safety Plan.
- Field book and project plan.
- Hand data entry sheets.
- Decontamination supplies (Alconox, buckets, potable water, distilled water, scrub brushes).

Slug Test Monitoring (Rising Head Test)

The following procedures will be used to conduct slug tests:

- Static water levels will be measured in each well to be tested prior to any testing (slug tests will not be performed in wells with LNAPL).
- Insert the transducer and then the slug into the water column of the well to be tested. Measure the change in water level using an electronic water level indicator. Allow the well to return to static conditions.

- While waiting for the well to return to static conditions, set up the data logger for recording. Input the required transducer parameters, the initial water level measurement, and set the measurement interval to the log scale (many early readings and increasingly longer time between readings as the test continues).
- Once the well has returned to static conditions, begin the slug test by quickly removing the slug from the well.
- Immediately begin recording the water level changes using the data logger and transducer previously inserted in the well. Also, begin to take hand measurements and recording them on the hand data sheets.
- Continue measurements until the well returns to static conditions. If the recovery is very slow, continue measurements for a maximum of one hour. The spacing between hand readings may be increased as the recovery rate slows through the test.
- At the end of each day or at the completion of the slug tests, download the data to a computer for data processing and interpretation.

Note: A falling head slug test may be conducted if the well screen is fully submerged. In a falling head test, the water level measurements will begin at the time of initial insertion of the slug and will continue as described above.

The slug test results will be interpreted based on the methods of Bouwer (1998), and Bouwer and Rice (1976).

4.4 TIDAL STUDY MEASUREMENTS

Groundwater and surface water level measurements in representative wells and a tidal gauging station will be made to establish a mean hydraulic gradient at the Quanta Site. As part of this program, the following tasks will be performed: 1) research previous oil/water gauging data in the wells, 2) conduct manual measurements and observations in applicable wells with an oil/water interface probe prior to the data logger testing, and 3) collect water level measurements over a 72-hour period in wells and tidal gauging stations using transducers and data loggers.

Equipment and Supplies for Tidal Study Measurements

- Electronic data logger (Hermit Model 3000 or equivalent) and either 5 or 10 psi transducers.
- Electronic water level indicator (Solinist or equivalent).
- Oil/water interface probe.
- Field Supplies (rope, duct tape).
- Personal protective equipment in accordance with the project Health and Safety Plan.
- Field book and project plan.
- Hand data entry sheets.

- Decontamination supplies (Alconox, buckets, potable water, distilled water, scrub brushes).

Tidal Study Monitoring

- Install a tidal gauging station along the Spencer Kellogg Pier, constructed of 2-inch, 10-slot, PVC. The bottom of the PVC will be set 10 feet below the low tide mark and affixed to the pier.
- The gauging station shall be surveyed for location and elevation.
- Initially, a review of the previous gauging events in the wells will be conducted. This will be done in order to choose representative wells that did not contain significant LNAPL for installation of transducers for the 72-hour testing.
- Collect depth to water measurements using a hand held oil/water interface probe (this will be done to confirm that no significant LNAPL was present in the wells, and to use as a reference for later calculations).
- During the field program, groundwater and surface water level measurements will be collected at 60-minute intervals for a 72-hour period. In the wells, the transducers will be installed to a predetermined depth, below any sheen or thin layer of oil present. In selected instances the transducers will be installed through a capped two-inch diameter PVC pipe set below the oil sheen. Once below the proper depth, the cap will be knocked out and the transducer set. This technique will be used to avoid possible contamination and malfunction of the transducer.
- Surface water level measurements will be collected at a newly installed tidal gauging station at the bulkhead and on the Spencer Kellogg pier.
- Manual oil/water interface probe measurements will be collected at the tidal gauging station twice a day to verify the electronic measurements recorded by the data logger.
- The tidal study results will be interpreted based on the methods of Serfes (1991).

4.5 BUILDING SURVEY FOR POTENTIAL IMPACTS TO INDOOR AIR QUALITY

A building survey and indoor air investigation will be undertaken at the commercial building located at 115 River Road to address potential impacts to indoor air quality. The investigation will be performed by 115 River Road, LLC using Environmental Waste Management Associates, LLC (EWMA) in order to better control the access and coordination with tenants.

A detailed work plan has been developed by EWMA for this work and it is included as Attachment A to this Work Plan. The general components of the work plan are documented in this RI/FS Work Plan for OU1; however, it should be noted that the indoor air investigation is being conducted independently by EWMA for 115 River Road, LLC. The work product and data generated from the EWMA investigation will be evaluated by Honeywell, QSAG and USEPA to determine if it is acceptable for use in the risk assessment portion of the Quanta RI. It is recognized that USEPA reserves the right to reject the data if it is not acceptable.

The scope of work for the vapor intrusion investigation was developed by EWMA and it is based on the guidance in the November 2002 document "*Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils*" issued by USEPA Office of Solid Waste and Emergency Response (OSWER). In addition, the existing interim "*Vapor Intrusion Pathway – Indoor Air Guidance*" issued by New Jersey Department of Environmental Protection (NJDEP) was used as a reference.

FIGURES

GROUND WATER / NAPL MEASUREMENTS RECORD

PARSONS

Client: Honeywell **Date:** ____________

Project: ____________ **Inspector:** ____________

Quanta Resources Site, Edgewater, New Jersey **Crew:** ____________

Comments: ____________ **Weather:** ____________

Liquid Indicator:

Note: all depths measured from marked location on riser

Well ID	Time (military)	Depth to LNAPL (ft)	Depth to Water (ft)	Depth to DNAPL (ft)	Depth to Bottom of Well (ft)	VOC Screen at Well Head (ppm)	Comments

INDOOR AIR QUALITY - BUILDING SURVEY

Occupant/Building Name: ______________________________ Date: ______________

Address: ____

Owner's Name: ________________ Address: ______________________________________

Completed by: ______________________________ Case #: ____________________

Building type: residential / office / commercial / industrial

Basement size: ____________ ft^3

Number of floors

below grade: ________ (full basement / crawl space / slab)

at or above grade: ________

Foundation type: poured concrete (over gravel) / cinder blocks / earthen /

other (specify) ____________________

Building occupants: Children under age 13 _____ Children age 13-18 _____ Adults _____

Contaminant Source Category	Yes	No	Comments/Locations
Outside Sources			
Garbage dumpsters			
Heavy motor vehicle traffic			
Construction activities			
Nearby industries (identify)			
NJDEP Comprehensive Site List (identify)			
UST/AST (gasoline, heating fuel)			
Basement Survey			
Wall construction (cinder block, sheet rock, paneling, etc.)			type: condition:
Floor Construction (earthen, slab, floating, etc.)			type: condition:
Was basement painted recently? oil-base or latex paints?			date: type of paint:
Sump present (PID/FID/CGI #s?)			

Location of sump			
New flooring in basement? (list type - carpet, tile)			
using glue			
New furniture added to basement			type: date:
Staining on floors/walls			
Pipes running through walls, floor (conduits - describe, give FID/PID/CGS readings)			
Odors detected by inspector			
Basement used as living space			
Time occupants spend in basement (hours/day per person)			
Items stored in basement: solvents			
gasoline			
paint/thinners			
polishes/waxes			
insecticides			
kerosene			
household cleaning products			
mothballs			
other items?			
Refer to Building Inventory Form for specific list			
First Floor Survey			
Wall construction (cinder block, sheet rock, paneling, etc.)			type: condition:
Was painting done recently? oil-base or latex?			date: type of paint:
New flooring on 1st Floor? (list type - carpet, tile)			
using glue			
New furniture added to 1st Floor			type: date:
Staining on floor/walls			
Pipes running through walls, floor (describe)			

Odors detected by inspector			
Items stored on this floor: solvents			
gasoline			
paint/thinners			
polishes/waxes			
insecticides			
kerosene			
household cleaning products			
mothballs			
other items?			
☛ *Refer to Building Inventory Form for specific list*			
Additional Floors (if necessary)			
Wall construction (cinder block, sheet rock, paneling, etc.)			type: condition:
Was painting done recently? oil-based or latex			date: type of paint:
Was new flooring installed? (list type - carpet, tile)			
using glue			
New furniture added			type: date:
Odors detected by inspector			
Items stored on this floor: solvents			
gasoline			
paint/thinners			
polishes/waxes			
insecticides			
kerosene			
household cleaning products			
mothballs			
other items?			
☛ *Refer to Building Inventory Form for specific list*			

Personal Activities			
Does anyone in the building smoke?			
approx. number of tobacco products per day, per person			
Does anyone dry-clean their clothes?			
Miscellaneous			
Have the occupants ever noticed unusual odors in building?			describe: location:
Known spill outside or inside building (specify location)			
Type of heating used in building oil			
natural gas			
kerosene			
electric			
other (specify)			
If heating oil, identify the location and age of the storage tank			
Is the heating unit properly vented?			
Water damage or standing water in building (historic or current)			
Fire damage to building			date:
Pest control applications			date:
Septic system			

Field Screening Results	FID	PID	CGI	CO_2	Rel. Hum.
Basement					
First Floor					
Additional Floors					
Other (specify) ________________					

INDOOR AIR QUALITY - BUILDING INVENTORY

Product Name	Container			Manufacturer's Name	Comments
	Quantity	Type	Size	City, State	

SECTION 5
SAMPLING EQUIPMENT AND PROCEDURES
FOR DRILLING PIEZOMETER/MONITORING WELL INSTALLATION

5.1 INTRODUCTION

The procedures and specifications for drilling using Geoprobe® methods, hollow stem augers (HSA) for soil cores and permanent well installation are described in this section. A New Jersey-licensed well driller will perform all borings and well installations. Additionally, all appropriate permits, well records, and forms will be completed as required by the NJDEP. Sampling procedures are described in Section 6.

5.2 DIRECT-PUSH SOIL BORINGS

The following direct-push procedures may be used for conducting soil borings at the site, if site conditions warrant:

Drilling Method

- Borings will be advanced using direct push-type direct push drilling methods to advance samplers to the specified depths (up to 50 feet).
- Samplers with dedicated acetate liners will be advanced to collect continuous samples to the bottom of each boring at the depths specified.
- If caving conditions are encountered, a retractable tip will be used to keep caved material out of the core sampler while it is being advanced through the depth last sampled to the next depth to be sampled. Casing may also be driven to depth if necessary.
- Soil samples retrieved from the borehole will be visually described for: 1) percent recovery, 2) soil type, 3) color, 4) moisture content, 5) texture, 6) grain size and shape, 7) consistency, 8) visible evidence of staining, and 9) any other observations. The soil descriptions will be in accordance with the ASTM D2488 and colors will be designated using a Munsell color chart.
- If necessary, a Shelby tube may be used to collect an undisturbed sample. Shelby tubes will be pushed into the low permeability material to obtain a sample of fine-grained material for permeability testing. Shelby tube sampling procedures are as follows: 1) Inspect Shelby tube prior to sampling. The tube should be free of rust and dents have a smooth inner seam, and a smooth sharp cutting edge, 2) Attach a Shelby tube sampler to the drill rods, 3) Lower the Shelby tube sampler to the bottom of the boring, 4) Push the Shelby tube sampler 6-inches or 2-feet into the undisturbed soil at a constant rate without rotating. Do not over pack the sampler, 5) Rotate the sampler one or two revolutions to shear the sample from the soil below and carefully remove from the borehole, 6) Both ends of the sample will be sealed in the sampler with wax (beeswax). (Note: care should be taken to minimize placing hot wax directly on samples to prevent wax penetrating into the sample, i.e. porous material. Wax should be at the point of hardened or mixed with a bulking material, i.e. oil, to prevent infiltration, before

placement), 7) Label the Shelby tube for sample ID and vertical orientation, 8) Store sample in the upright position in a place where it will not be subject to vibrations, sudden shock, drying out, or temperatures below 32°F, 9) Samples will be hand delivered or shipped via mail to the laboratory. If samples are sent via mail, appropriate labeling will be used to indicate that the package should remain in an upright position,

- The entire soil column will be field screened for volatile organic vapors. The remaining soil sample will be placed into a 16-ounce driller's jar (or larger as necessary) or in a "Ziplock®" bag at 2-foot intervals. The container(s) will be labeled with the boring number and interval sampled, and staged in a designated area for potential future geotechnical analysis.
- A head space measurement will be made from the sample container as described below. After a minimum of 10 minutes, the lid will be unscrewed or the bag will be unzipped enough to allow the tip of the PID to be inserted into the container to measure the headspace for volatile organic vapors.
- Any surplus soil samples will be disposed of in accordance with methods specified in Section 3.3.
- All drilling equipment will be decontaminated between each boring in accordance with methods specified in Section 3.2.
- The designated field geologist will log borehole geology and headspace measurements in the boring log. The information obtained will include all of the data required to complete the boring log shown in Figure 5-1.
- Surface soil samples from 0 to 6 inches will be collected directly using hand tools if possible.

5.3 MONITORING WELL SOIL BORINGS

The following procedures will be used for conducting soil borings at the site:

<u>Drilling Method</u>

- Borings will be advanced with 4.25-inch or 8.25-inch hollow stem augers (HSA) to the specified depth as prescribed in the Work Plan.
- Split-spoon samples will be collected continuously from the ground surface to the specified depth in each boring in accordance with ASTM Specification D-1586-84 for standard penetration test and split-spoon sampling.
- After collecting each split-spoon sample, the borehole will be drilled to a depth equal to the top of the next sampling interval unless the geologist authorizes otherwise.
- Soil samples retrieved from the borehole will be visually described for: 1) percent recovery, 2) soil type, 3) color, 4) moisture content, 5) texture, 6) grain size and shape, 7) consistency, 8) visible evidence of staining, and 9) any other observations. The descriptions will be recorded in accordance with ASTM D2488 and color will be assigned using a Munsell color chart.

- All soil samples will be screened for the presence of organic vapors with a PID.
- Soil samples will be collected as necessary in six-inch intervals and submitted for analytical parameters.
- Selected samples will be screened for petroleum vapors or NAPLs using a PID, Sudan IV kit, or UV Florescence.
- The remainder of the soil sample will be placed into a 16-ounce driller's jar (or larger as necessary) or in a "Ziplock®" bag. The container(s) will be labeled with the boring number and interval sampled, and staged in a designated area for potential future geotechnical analysis.
- A headspace measurement will be made from the sample container as described below. After a minimum of 10 minutes, the lid will be unscrewed or the bag will be unzipped enough to allow the tip of the PID to be inserted into the container to measure the headspace for vapors.
- Drill cuttings will be disposed of in accordance with methods specified in Section 3.3.
- All drilling equipment will be decontaminated between each boring in accordance with methods specified in Section 3.2.
- The designated field geologist will log borehole geology and headspace measurements in the boring log. The information obtained will include all of the data required to complete the boring log shown in Figure 5-1.

5.4 NAPL DELINEATION

All soil samples (collected from soil borings or test pits) will be observed for the presence or absence of NAPL in the field. The following field methods will be used to determine the presence or likelihood of residual and free phase NAPL:

- Visual Observations – The onsite geologist will visually observe the soil sample for the presence or absence of NAPL.

- Jar-Head Space – Using a PID, the onsite geologist will conduct a jar-head space test to determine if NAPL is present. If the result is less than 100 ppm and no NAPL was visually observed, then NAPL is determined to not likely be present.

- Sudan IV or UV Fluorescence Test – If the jar-head space test is greater than 100 ppm, then either a Sudan IV or UV Fluorescence (i.e., Site Lab UVF-3100 or similar kit) test will be run.

- Analytical Testing – Analytical testing will be run to confirm delineation if warranted.

5.5 WELL INSTALLATION

Monitoring wells will be installed with well screens across the water table to allow groundwater sampling, monitoring of water levels, monitoring of possible LNAPL, and aquifer testing using slug test methods; at selected wells, the screens will be installed below the water table. Monitoring wells will be constructed of PVC for short term monitoring solutions during the RI. Long term monitoring wells installed after the RI will be constructed using stainless steel screens. PVC wells screens shall be replaced with stainless steel during the RI if the PVC well screens are found to be compromised (e.g., due to swelling). Figure 5-2 shows an example monitoring well construction log.

Equipment

- Field book and project plans.
- Personal protective equipment in accordance with the HSP.
- Metal detector.
- Water level indicator.
- PID and multi-gas meter.
- Explosimeter.
- Driller's jars (16 oz.).
- Jar labels.
- Camera.

5.5.1 Permanent Monitoring Wells

- Monitoring wells labeled 'A' will be screened across the water table, wells labeled 'B' will have the sump set into the silt/clay layer with the screen extending across the water table, and doubled cased deep wells (labeled 'DS') will be screened below the confining unit. The drilling methods will be as described in Section 5.3.
- Shallow (A) and intermediate (B) wells will be constructed within the augers using 4-inch, inside diameter (ID), threaded, flush joint, PVC casings, and 10-slot screens.
- Deep wells (DS) set below the confining unit will be constructed of a 6-inch outer steel casing driven into the clay silt confining unit, and 2-inch ID, threaded, flush-joint, PVC casings and 10-slot screen installed inside the outer casing.
- At DS wells, a 6-inch steel casing will be installed by drilling at least 5 feet into the clay silt-confining unit using hollow stem auger. The augers will be lifted and the bottom of the hole will be filled with cement bentonite grout. A shoe will be placed on the bottom of the 6-inch steel casing and the steel casing pushed to the drilled depth, allowing the cement bentonite to form an annular seal. The remainder of the annulus will be grouted to the surface and allowed to set for 24 hours before drilling and installation of the well casing.
- Install riser pipe above the screen and extending approximately 3 feet above the ground surface unless the well is to be completed as a flush mount.
- The top of the casing will extend to approximately 3 feet above ground surface.
- Install a vented cap on the top of each riser pipe.

- The annulus around the screens will be backfilled with silica sand complementing the screen slot size to a height of 1 foot above the top of the screen.
- A fine sand ('sugar sand') with a minimum thickness of 2 feet will be placed above the sand pack.
- The remainder of the annular space will be filled with a cement-bentonite grout to the ground surface. The grout will be pumped from the bottom up with a tremie pipe. The grout will be allowed to set for a minimum of 24 hours before wells are developed.
- Each monitoring well will have a vented cap and steel locking protective casing with locking cap placed over it.
- A 2-feet by 2-feet gravel mix concrete pad will be sloped to channel water away from the well, and be 12 inches deep to remain stable during freezing and thawing of the ground.
- A weep hole will be drilled at the base of the outer casing to allow any water between the inner and outer casing to drain.
- The top of the PVC well casing and outer protective casing will be marked and surveyed to an accuracy of 0.01 foot, and elevations will be determined relative to a fixed benchmark or datum.
- The measuring point on all wells will be on the innermost casing.
- Monitoring well construction details will be recorded in the field book and on the well construction log shown in Figure 5-2.

5.6 WELL DEVELOPMENT

The new and existing monitoring wells will be developed prior to sampling in accordance with the USEPA's guidelines (EPA Ground Water Forum, 1992). Each monitoring well will be developed until the water is turbid free, using the methods described in USEPA guidance:

The development water will be contained in 55-gallon drums and stored onsite. Purge water will be considered investigation of derived waste and disposed of in accordance with Federal and State of New Jersey regulations. The specific capacity of the well will be measured during development. If the development criteria have not been met, the data will be reviewed to determine whether development is considered completed or whether additional development or a change in development method is required. Development will not start until 24 hours have passed since the installation of the well.

5.7 BORING, WELL, AND PIEZOMETER ABANDONMENT

All test borings not completed as monitoring wells will be backfilled with bentonite or cement/bentonite grout. Well/Piezometer abandonment, if required, will be accomplished by one of the following methods in accordance with the NJDEP Bureau of Water Allocation regulations:

- Wells and piezometers will be abandoned by overdrilling the well/piezometer to remove all well materials. Auger soils and removed well materials will be containerized for proper disposal. The resulting borehole will then be backfilled with cement/bentonite grout to near the ground surface. In certain cases where site conditions or planned future activities may require, the borehole may be abandoned with a bentonite slurry or hydrated bentonite chips.

- If a piezometer/ well cannot be abandoned by overdrilling, it will be abandoned by extracting the well casing and screen from the subsurface by lifting while filling the resulting void space with a bentonite-cement grout. A drill rod or other tool will be used to break out the bottom plug prior to pulling and grouting.
- If the piezometer/ well cannot be abandoned as described above, the well casing will be filled with grout to a level of 5 feet below the land surface (after settling), the well casing will be cut at a depth of 5 feet below the surface, and the detached casing and attached well materials will be removed from the ground.
- All required NJDEP reports/forms will be completed and submitted to the Bureau of Water Allocation by the driller.

FIGURES

BORING CONSTRUCTION LOG

PARSONS	CLIENT: Honeywell	BORING NO.:

PROJECT : QUANTA RESOURCES - EDGEWATER, NJ

SWMU # (AREA) :

SOP NO.:

START DATE:

FINISH DATE:

CONTRACTOR:

DRILLER:

INSPECTOR:

CHECKED BY:

CHECK DATE:

BORING CONVERTED TO MW? Y N

DRILLING SUMMARY

DRILLING	HOLE	DEPTH	SAMPLER		HAMMER	
METHOD	DIA.(ft)	INTERVAL (ft)	SIZE	TYPE	TYPE	WT/FALL

DRILLING ACRONYMS

HSA	HOLLOW-STEM AUGERS	HMR	HAMMER	SS	SPLIT SPOON
DW	DRIVE-AND-WASH	SHR	SAFETY HAMMER	CS	CONTINUOUS SAMPLING
MRSLC	MUD-ROTARY SOIL-CORING	HHR	HYDRAULIC HAMMER	5I	5 FT INTERVAL SAMPLING
CA	CASING ADVANCER	DHR	DOWN-HOLE HAMMER	NS	NO SAMPLING
SPC	SPIN CASING	WL	WIRE-LINE	ST	SHELBY TUBE
				3S	3 INCH SPLIT SPOON

MONITORING EQUIPMENT SUMMARY

INSTRUMENT	DETECTOR	RANGE	BACKGROUND			CALIBRATION		WEATHER
TYPE	TYPE/ENERGY		READING	TIME	DATE	TIME	DATE	(TEMP., WIND, ETC.)

MONITORING ACRONYMS

PID	PHOTO - IONIZATION DETECTOR	BGD	BACKGROUND	DGRT	DRAEGER TUBES
FID	FLAME - IONIZATION DETECTOR	CPM	COUNTS PER MINUTE	PPB	PARTS PER BILLION
GMD	GEIGER MUELLER DETECTOR	PPM	PARTS PER MILLION	MDL	METHOD DETECTION LIMIT
SCT	SCINTILLATION DETECTOR	RAD	RADIATION METER		

INVESTIGATION DERIVED WASTE

DATE			
SOIL AMOUNT : (fraction of drum)			
DRUM #, LOCATION:			

COMMENTS:

SAMPLES TAKEN:

SAMPLES

DUPLICATES

MS/MSD

MRD

BORING CONSTRUCTION LOG

PARSONS	CLIENT: HONEYWELL	BORING NO.:

COMMENTS:

DRILLER:

INSPECTOR:

DATE:

DEPTH (FT)	SAMPLING			SAMPLE				SAMPLE DESCRIPTION (As per Burmeister: color, grain size, MAJOR COMPONENT, Minor Components with amount modifiers and grain-size, density, stratification, wetness, etc.)	USCS CLASS	STRATUM CLASS
	BLOWS PER 6 INCHES	PENE-TRATION RANGE (FEET)	RECOV-ERY RANGE (FEET)	DEPTH INT (FEET)	NO.	VOC	RAD SCRN			
5										
10										
15										
20										

FIG A-2 (cont.)

BORING CONSTRUCTION LOG

PARSONS	CLIENT: HONEYWELL	BORING NO.:

COMMENTS:

DRILLER:

INSPECTOR:

DATE:

DEPTH (FT)	SAMPLING			SAMPLE				SAMPLE DESCRIPTION (As per Burmeister: color, grain size, MAJOR COMPONENT, Minor Components with amount modifiers and grain-size, density, stratification, wetness, etc.)	USCS CLASS	STRATUM CLASS
	BLOWS PER 6 INCHES	PENE-TRATION RANGE (FEET)	RECOV-ERY RANGE (FEET)	DEPTH INT (FEET)	NO.	VOC	RAD SCRN			

FIGURE A-2 (cont.)

PERMANENT MONITORING WELL CONSTRUCTION LOG
COMPLETION REPORT & INSTALLATION DETAIL
ROADWAY BOX - SURFACE COMPLETION

PARSONS	CLIENT:	WELL #:

PROJECT: ____________ PROJECT NO: ____________
SWMU # (AREA): ____________ INSPECTOR: ____________
SOP NO.: ____________ CHECKED BY: ____________

DRILLING CONTRACTOR: ____________ POW DEPTH (ft) : ____________
DRILLER: ____________ INSTALLATION STARTED: ____________
DRILLING COMPLETED: ____________ INSTALLATION COMPLETED: ____________
BORING DEPTH: ____________ SURFACE COMPLETION DATE: ____________
DRILLING METHOD(S): ____________ COMPLETION CONTRACTOR/CREW: ____________
BORING DIAMETER(S): ____________ BEDROCK CONFIRMED (Y/N?) ____________

PROTECTIVE SURFACE CASING

DIAMETER (ft): ____________ LENGTH (ft): ____________

RISER

TYPE: ____________ TR (ft): ____________
DIAMETER(in): ____________ LENGTH (ft): ____________

SURFACE COLLAR

TYPE: ____________ RADIUS (ft): ____________
THICKNESS OF CENTER (ft): ____________ THICKNESS OF EDGE (in): ____________

SCREEN

TYPE: ____________ TSC (ft): ____________
DIAMETER (in): ____________ SLOT SIZE: ____________ LENGTH (ft): ____________

POINT OF WELL (SILT SUMP)

TYPE: ____________ BSC (ft): ____________ POW(ft): ____________

GROUT

TYPE: ____________ TG (ft): ____________ LENGTH (ft): ____________

SEAL

TYPE: ____________ TBS (ft): ____________ LENGTH (ft): ____________

SAND PACK

FINE SAND TYPE: ____________ TSP (ft): ____________ LENGTH (ft): ____________
COARSE SAND TYPE: ____________ TSP (ft): ____________ LENGTH (ft): ____________

ACRONYMS

TR	Top of Riser	BSC	Bottom of Screen	TG	Top of Grout
TSC	Top of Screen	POW	Point of Well	TBS	Top of Bentonite Seal
BGD	Background	TSP	Top of Sand Pack		

COMMENTS:

* ALL DEPTH MEASUREMENTS REFERENCED TO GROUND SURFACE

SEE PAGE 2 FOR SCHEMATIC

FIGURE 5-2

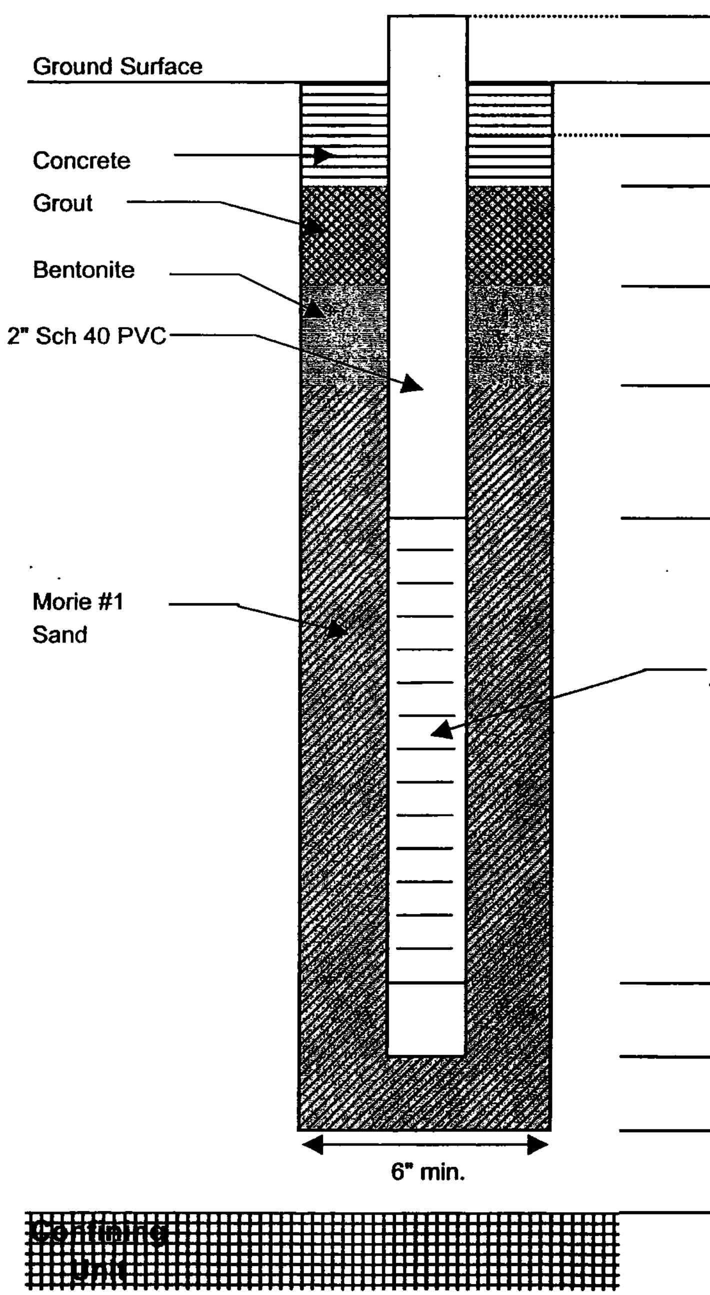
PERMANENT MONITORING WELL CONSTRUCTION LOG

PARSONS | **Site:** | **Location:**

Date Well Installed: ____________________

Well No. ____________________ **NJDEP Permit No.:** ____________________

Surface Completion: Road Box Stick-up
(circle one)



	Depth Relative to Groundsurface (ft)
TOC Stick-up	
Ground Surface	0.0
TOC Road Box	
Top of grout	
Top of Bentonite Seal	
Top of Morie #1 Sand	
Top of screen	
Bottom of screen	
Bottom of sump	
Bottom of borehole	

Not to scale

TEMPORARY MONITORING WELL CONSTRUCTION LOG - INFORMATION

Parsons

Client: ____________________

Project: ____________________

Location:

Well ID: ____________________

Blanket permit #: ____________________

Inspector: ____________________

Drill contractor: ____________________

Driller: ____________________

Date installed: ____________________

Boring diameter: ____________________

Temporary Well Stick-up (ft) ____________________

Was NAPL present prior to evacuation?: ____________________

Depth to NAPL prior to evacuation (ft): ____________________

Depth to groundwater prior to evacuation (ft): ____________________

NAPL thickness prior to evacuation (ft): ____________________

Date of evacuation: ____________________

Method of evacuation: ____________________

Was NAPL observed during evacuation?: ____________________

Date removed/sealed: ____________________

Sealing method: ____________________

Note: All well measurements in feet below top of well casing.

Temporary Monitoring Well Construction Log

Quanta Resources RI/FS

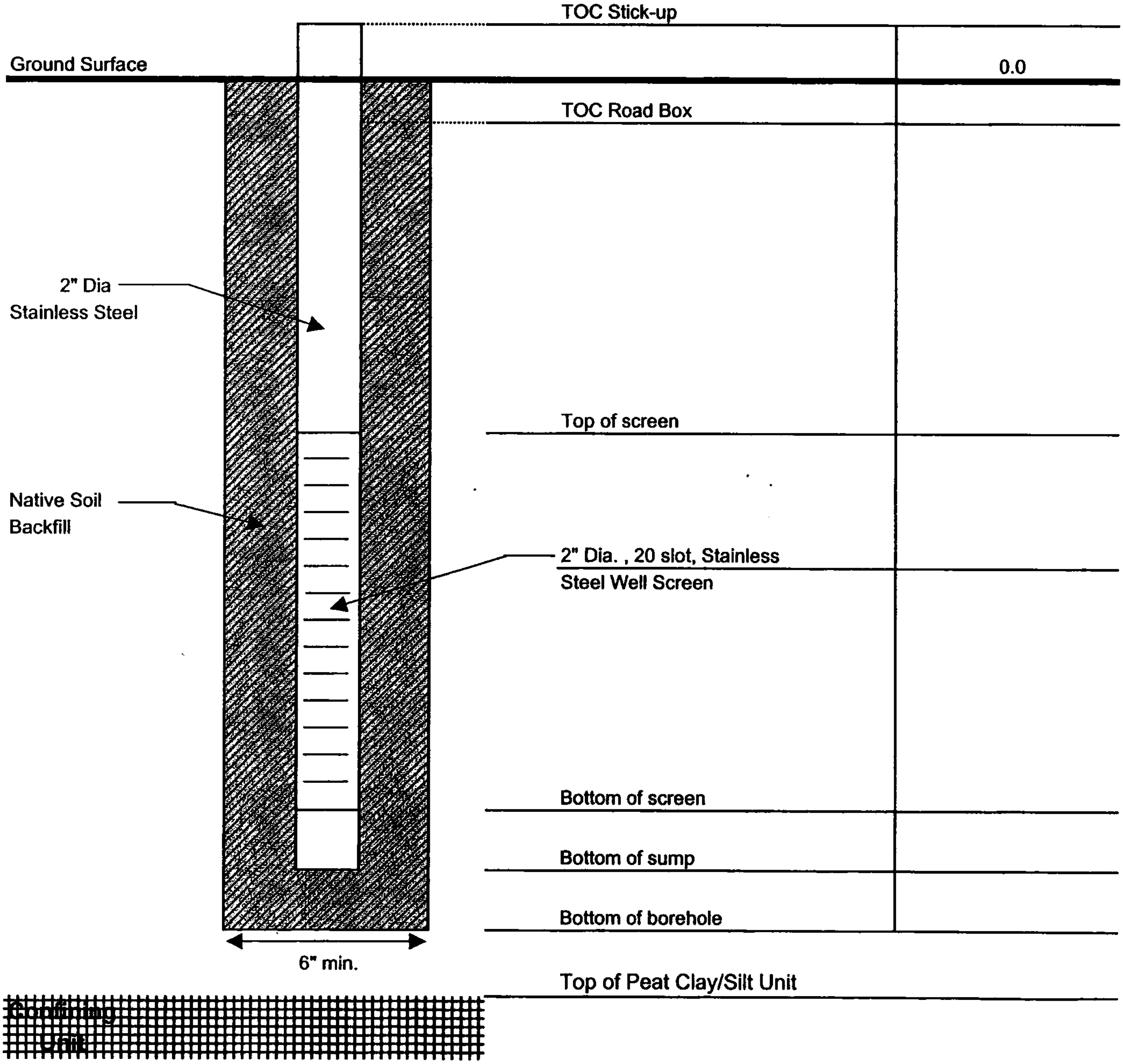
Parsons	Client:	Location:

Date Well Installed:

Well No. **NJBWA Blanket Permit No.:**

Depth Relative to Groundsurface (ft)

Surface Completion: Road Box Stick-up
(circle one)



Not to scale

Figure 5-3

WELL DEVELOPMENT RECORD

PARSONS	CLIENT :	WELL #:

PROGRAM TYPE : REMEDIAL INVESTIGATION	CREW INITIALS	START DATE	END DATE
SWMU # (AREA) :			
PROJECT NO. (JOB #):			

	MONITORING	BEFORE DEVELOPMENT		AFTER DEVELOPMENT	
DRILLING DATE:					
INSTALLATION DATE:	INSTRUMENT	OVM	RAD	OVM	RAD
SOP REFERENCE NO. & REV. NO. :	READING				
PUMP EQUIPMENT:	UNITS (ppm or cps)				

WELL TYPE (circle one)	BEDROCK	OVERBURDEN	MEASURED WATER DEPTH (feet from TOC):
WELL INNER RISER DIAMETER (inches)			MEASURED POW DEPTH (feet from TOC):
WELL DIAMETER FACTOR (gal/ft)			WATER COLUMN (feet) :
BORING DIAMETER (inches)			INSTALLED WATER DEPTH (feet from TOC):
BORING DIAMETER FACTOR (gal/ft)			INSTALLED POW DEPTH (feet from TOC):

1. STANDING VOLUME INSIDE WELL = WATER COLUMN X WELL DIAMETER FACTOR = ______________ GAL. = A

2. STANDING WATER IN ANNULAR SPACE =
   WATER COLUMN BELOW SEAL(ft) X (BORING DIAMETER FACTOR - WELL DIAMETER FACTOR) X 0.3 = ______________ GAL. = B

3. SINGLE STANDING WATER VOLUME = A + B ______________ GAL. = C

4. MINIMUM VOLUME TO BE REMOVED = 3 X C ______________ GALS.

DATE	ACTIVITY	START TIME (military)	END TIME (military)	GALLONS REMOVED PER TIME PERIOD	pH	CONDUCTIVITY (umhos/cm)	TEMPERATURE (degrees C)	TURBIDITY (NTUs)
	TOTALS/FINAL							

COMMENTS:

INVESTIGATION DERIVED WASTE (IDW) :

DATE			
GALLONS OF WASTE WATER			
DRUM NO. & LOCATION			

Figure 5-4

WELL DEVELOPMENT REPORT (cont'd)

PARSONS	DATE :	WELL #:

PROGRAM TYPE : REMEDIAL INVESTIGATION	CREW INITIALS	START DATE	END DATE
SWMU # (AREA) :			
PROJECT NO. (JOB #):			

DATE	ACTIVITY	START TIME (military)	END TIME (military)	GALLONS REMOVED PER TIME PERIOD	pH	CONDUCTIVITY (umhos/cm)	TEMPERATURE (degrees C)	TURBIDITY (NTUs)
	TOTALS/FINAL							

COMMENTS:

INVESTIGATION DERIVED WASTE (IDW) :

DATE			
GALLONS OF WASTE WATER			
DRUM NO. & LOCATION			

SECTION 6
SAMPLING EQUIPMENT AND PROCEDURES FOR FIELD SAMPLE COLLECTION

6.1 INTRODUCTION

Procedures for obtaining samples of various environmental media are described in this section. Sample handling and procedures are described in Section 7.

6.2 SUBSURFACE SOIL SAMPLES FROM SPLIT-SPOONS AND MACROCORES

Subsurface soil samples will be collected during drilling of the soil borings. Drilling and logging methods for soil borings are described in Section 5. Subsurface soil samples for laboratory analyses will be collected in accordance with the NJDEP Field Sampling Procedures Manual (1992) using the following techniques:

<u>Sampling Method</u>

- Subsurface soil samples will be collected and screened for the presence of vapors in accordance with procedures described in Section 5.
- Soil samples will be collected in six-inch intervals and submitted for analytical analysis (following Table 1-2) at the surface (0-6 inches), just above the water table, a depth selected the field based on field screening evidence, and 2 feet into the clay silt-confining unit.
- VOC samples will be collected from a discreet six-inch interval using an Encore™ or similar plunger-type system.
- The remainder of each split-spoon sample or Macrocore® sample will be placed in a 16-ounce driller's jar or "Ziplock®" bag.
- Those soil samples not selected for chemical analysis will be staged for possible geotechnical analysis. The geotechnical analyses require as much soil as possible so the entire contents of each split spoon will be placed in the driller's jars or "Ziplock®" bags.
- Chain-of-custody procedures will be followed.
- The sampling equipment will be decontaminated between samples in accordance with procedures described in Section 3.
- Sample description, depth, and location will be recorded in the field book and on the boring log (Figure 5-1).

6.3 GROUND WATER SAMPLES

The following procedure will be used to collect ground water samples from selected wells:

Low Flow Sampling Method

- The monitoring well will be purged and sampling using low flow methods as described in the 1998 USEPA Region II Groundwater Sampling Procedure Low Stress (Low Flow) Purging and Sampling, the 1992 NJDEP Field Sampling Procedures Manual, and as summarized below.
- All newly installed monitoring wells will be allowed to stabilize and equilibrate with the aquifer for a minimum of two weeks prior to sampling.
- Before purging, a round of water levels will be measured in the site wells and recorded on the Groundwater/NAPL Measurement Form (Figure 4-1).
- During the first low flow sampling event, the pump intake will be placed so that vertical samples can be collected in five-foot intervals. In additional low flow sampling rounds, the pump intake will be determined by existing data.
- The monitoring wells will be purged at a rate of 200 to 500 mL per minute using a decontaminated pump and dedicated tubing. Lower pumping rate if draw down exceeds 0.3 feet.
- The purge water will be monitored for Eh, DO, specific conductance, pH, temperature and turbidity at approximately 5-minute intervals, or at every well volume.
- The water levels in the wells will be monitored to assess drawdown. A pumping rate should be selected which will minimize drawdown in the well being pumped.
- When three consecutive readings have stabilized (+/- 0.1 pH, +/- 3% specific conductance, 10mv for redox, and +/- 10% for DO and turbidity) or 4 hour of pumping has been conducted, the sample will be collected. Readings and observations will be recorded in the ground water sampling record (Figure 6-1).
- The sample will be collected at a pumping rate of 100mL/min to 250 mL/min (drawdown less than 0.3 feet). The laboratory bottles will be filled directly from the dedicated tubing discharge.
- Well sampling data will be recorded on the ground water sampling record shown in Figure 6-1.
- All development water will be disposed of by methods described in Section 3.3.

FIGURES

GROUND WATER SAMPLING RECORD

PARSONS	CLIENT:	WELL # :

PROJECT (STUDY_ID):		DATE:	
SWMU # (AREA):		LABORATORY :	
SCREENED INTERVAL (TOC):		MONITORING DATE:	
STATE WELL PERMIT #:		INSTRUMENT	DETECTOR
WEATHER:		PID / FID	
FREE PRODUCT (NO/ YES) Thickness			

BOREHOLE DIAMETER FACTORS

DIAMETER (INCHES):	1	1.5	2	3	4	5	6	7	8	9	10
GALLONS/FOOT:	0.041	0.092	0.163	0.367	0.654	1.02	1.47	2.00	2.61	3.30	5.87

PURGE METHOD:		WELL HEAD VOC CONCENTRATION (ppm):	
STATIC DEPTH TO WATER (TOC):		STANDING WATER VOLUME IN WELL (gallons):	
WELL DEPTH (TOC):		THREE WELL VOLUMES (gallons):	
FEET OF WATER IN WELL:		ONE:	TWO: THREE:

PURGING DATA:

Measure indicator parameters after each volume (at 1/2 volume if more than 3 required*)

TIME BEGIN PURGING: TIME END PURGING:

Time:								
Depth to Water (ft)								
Depth to bottom opening of Purge Device (TOC)								
Flow Rate (ml/min.)								
Volume of Water Removed (gals)								
pH								
Specific Conductivity (umhos)								
Dissolve Oxygen (DO)								
Temperature (deg. C)								
ORP (mV)								
Turbidity (NTU)								

DEPTH TO WATER MEASUREMENTS AFTER PURGING

Date	Time	Depth to Water (ft) "After Purge"	Pre-Purge / "Static" Water Column (ft)	Water Column (ft)	% RECOVERY

Notes:

* **Purging should not exceed 5 volumes**

(1) Determine water column in the borehole(for both "after purge" and "static" conditions) by subtracting the measured water level from the well point.

(2) Divide the "after purge" water column by the "static" water column and multiply by 100 to determine the percent of recovery for the well.

SAMPLING INFORMATION

Well Number: ____________________

SAMPLING DEVICE:

SAMPLE PARAMETER	TIME	CONTAINER	COLOR	TURBIDITY SAMPLE TAKEN AFTER (CHECK ONE)

QA\QC:

QA/QC DUPLICATE SAMPLE COLLECTED: YES or NO

Duplicate Sample Name:

QA\QC RINSATE SAMPLE NAME:

MATRIX SPIKE SAMPLE COLLECTED: YES or NO

INVESTIGATION DERIVED WASTE (IDW):

Date:					
Volume Transfered to Drum:					
Drum Number:					

COMMENTS:

SECTION 7
SAMPLE HANDLING AND ANALYSIS

7.1 SAMPLE DESIGNATION

Each sample will be given a unique alphanumeric identifier in accordance with the classification system shown in Table 7-1. Duplicate samples will be assigned identifiers that do not allow the laboratory to distinguish them as duplicates. Each sample container will be labeled prior to packing for shipment. The sample identifier, site name, date and time of sampling, and analytical parameters will be written on the label in waterproof ink and recorded in the field book.

7.2 SAMPLE CONTAINERIZATION, PRESERVATION AND ANALYSIS

Sample containerization, holding time requirements, and preservation requirements are listed in Section 4 of the QAPP. Field handling and storage of samples and sample containers is described in Section 5 of the QAPP. Analytical methods for sample analyses are listed in Section 7 of the QAPP.

7.3 CHAIN OF CUSTODY

A Chain-of-Custody (COC) record (Figure 7-1) will accompany the sample containers during selection and preparation at the laboratory, during shipment to the field, and during return shipment to the laboratory. The COC will identify each sample container and the analytical parameters for each, and will list the field personnel that collected the samples, the project name and number, the name of the analytical laboratory that will receive the samples, and the method of sample shipment. If samples are split and sent to different laboratories, a copy of the COC record will be sent with each sample shipment.

Method

- Field personnel will complete the COC as samples are collected and packed for shipment.
- Erroneous markings will be crossed-out with a single line and initialed by the author.
- The Special Instructions space will be used to indicate if the sample is a matrix spike, matrix spike duplicate, or matrix duplicate.
- Trip and field blanks will be listed on separate rows.
- After the samples have been collected and sample information has been listed on the COC form, the method of shipment, the shipping cooler identification number(s), and the shipper air bill number will be entered on the COC.
- Finally, a member of the sampling team will write his/her signature, the date, and time on the first RELINQUISHED BY space. Duplicate copies of each COC must be completed.
- Sampling personnel will retain one copy of the COC. The other copy and the original will be sealed in a plastic bag and taped inside the lid of the shipping cooler.

- Blind duplicate samples will be cross-referenced to the corresponding field sample only on the copy of the COC retained by the sampling personnel. The samples will remain blind samples on the two copies of the COC sent to the laboratory.
- Sample shipments going to chemical analytical laboratories will be refrigerated at 4°C, typically by packing with ice, to preserve the samples during shipment. Samples going to geotechnical labs for geotechnical analyses will not require refrigeration.
- After the shipping cooler is closed, custody seals provided by the laboratory will be affixed to the latch and across the front and back of the cooler lid, and signed by the person relinquishing the samples to the shipper.
- The seal will be covered with clear tape, and the cooler lid will be secured by wrapping with packing tape.
- Then the cooler will be relinquished to laboratory or the shipper, typically an overnight carrier.
- The COC seal must be broken to open the container. Breakage of the seals before receipt at the laboratory may indicate tampering. If tampering is apparent, the laboratory will contact the Parsons Project Manager, and the samples will not be analyzed.
- The chemical analytical samples must be delivered to the laboratory within 48 hours of collection.

7.4 SAMPLE DOCUMENTATION

The field team leader will retain a copy of the COC, and, in addition, the field team leader will ensure that the following information about each sample is recorded in the field book or sample log:

- Sample identifier;
- Sample identifier of blind duplicate samples and cross reference to corresponding field sample;
- Identification of other QA/QC samples and cross reference to corresponding field samples;
- Identification of sampled media (e.g., soil or groundwater);
- Sample location with respect to known reference point;
- Physical description of sample location;
- Field measurements, (e.g., pH, temperature, conductivity, and water levels);
- Date and time of collection;
- Sample collection method;
- Volume of groundwater purged before sampling;
- Number of sample containers;
- Analytical parameters;

- Preservatives used; and
- Shipping information:
  - Dates and method of sample shipments,
  - Chain-of-Custody Record numbers,
  - FedEx Air Bill numbers, and
  - Sample recipient (e.g., laboratory name).

TABLES

Table 7-1
Sample Designation
Quanta Resources Site
Edgewater, New Jersey

SAMPLE IDENTIFIER:

Sample Type	Sample Number	Depth Code	QC Identifier
LL	NN	N-N	LL

L = Letter
N = Number

SAMPLE TYPES:

Solid	Water
SS - Surface soil	GW – Ground water
SB - Subsurface soil from soil boring	DW - Drill Water/Decon Water

SAMPLE NUMBER: Number referenced to a sample location map. Samples are numbered consecutively beginning with the next number following any previous samples.

DEPTH CODE: Depth in feet of sample interval: (example, 4-4.5).

QC IDENTIFIER:
XX - Sample
FB - Field Blank
TB - Trip Blank
RB - Rinse Blank
MS - Matrix Spike
MD - Matrix Spike Duplicate
MB - Matrix Blank

BLIND DUPLICATE IDENTIFIER: Blind duplicate samples will have a unique sample ID that is different than the corresponding field sample but that fits the general sample ID scheme. These samples will be cross referenced in the field log book and on the third copy of the COC retained by the field sampling team. The sample IDs will remain "blind" on the copies of the COC sent to the laboratory.

FIGURES

CHAIN OF CUSTODY

ACCUTEST Laboratories

2235 Route 130, Dayton, NJ 08810
732-329-0200 FAX: 732-329-3499/3480

FED-EX Tracking #	Bottle Order Control #
Accutest Quote #	Accutest Job #

Client / Reporting Information		Project Information	
Company Name	0	Project Name:	
Address		Street	
City State Zip		City State	
Project Contact: E-mail		Project #	
Phone #		Fax #	
Samplers's Name		Client Purchase Order #	

Requested Analysis: BTEX; 8260 ☐ 624 ☐ 8021 ☐ 602 ☐ MTBE ☐ TBA☐ NAP ☐; 8260 ☐ 624 ☐ TCL ☐ PPL ☐ STARS ☐ MTBE ☐ TBA ☐ NAP☐ +10 ☐ +15 ☐; 8270 ☐ 625 ☐ TCL ☐ PPL ☐ STARS☐ ABN☐ AE☐ BN☐ PAH☐ +TICs☐

Matrix Codes: DW- Drinking Water; GW- Ground Water; WW- Water; SW- Surface Water; SO- Soil; SL-Sludge; OI-Oil; LIQ- Other Liquid; AIR- Air; SOL-Other Solid; WP-Wipe

Accutest Sample #	Field ID / Point of Collection	SUMMA # MEOH Vial #	Collection Date	Collection Time	Sampled by	Matrix	# of bottles	HCl	NaOH	HNO3	H2SO4	NONE	NaHSO4	MEOH	ENCORE	Requested Analysis	LAB USE ONLY

Turnaround Time (Business days)

	Approved By:/ Date:
☐ Std. 15 Business Days	
☐ 10 Day *RUSH*	
☐ 5 Day *RUSH*	
☐ 3 Day *EMERGENCY*	
☐ 2 Day *EMERGENCY*	
☐ 1 Day *EMERGENCY*	
☐ Other	

Emergency T/A data available VIA Lablink

Data Deliverable Information

☐ Commercial "A"	☐ FULL CLP
☐ Commercial "B"	☐ NYASP Category A
☐ NJ Reduced	☐ NYASP Category B
☐ NJ Full	☐ State Forms
☐ Other ________	☐ EDD Format________

Commercial "A" = Results Only

Comments / Remarks

Sample Custody must be documented below each time samples change possession, including courier delivery.

Relinquished by Sampler:	Date Time:	Received By:	Relinquished By:	Date Time:	Received By:
1		1	2		2
Relinquished by: 3	Date Time:	Received By: 3	Relinquished By: 4	Date Time:	Received By: 4
Relinquished by: 5	Date Time:	Received By: 5	Custody Seal #	Preserved where applicable ☐	On Ice ☐ Cooler Temp.

STL
Edison
A division of
Severn Trent
Laboratories, Inc.

CUSTODY SEAL

Date____________________

Signature____________________

No. 57900

SECTION 8
SAMPLING QA AUDITS

8.1 SAMPLING QA AUDITS

Sampling quality assurance (QA) audits may be conducted to verify that fieldwork is conducted in accordance with the procedures specified in this document. The QA audits will be performed by the approved quality assurance officer (QAO) or a qualified designee under the direction of the QAO. The designee will not have responsibility for the project work associated with the audit.

Sampling QA audits will include, but will not be limited to, review of the following items:

- Decontamination procedures;
- Sampling procedures;
- Sampling container cleanliness, size, and material;
- Sample identification (labels and COC);
- Sample handling, preservation, and shipping;
- Sample tracking;
- Maintenance and calibration of sampling equipment; and
- Corrective action.

An audit report must be submitted to the Parsons Project Manager within 15 days of completion of the audit. Serious deficiencies will be reported to the Project Manager within 24 hours. This may be accomplished by issuing a Corrective Action Request (CAR) (Figure 8-1). The CAR identifies the out-of-compliance condition, reference documents, and recommended corrective action. The CAR will be issued to the individual(s) responsible for the noncompliance and to the Project Manager. The individual to whom the CAR is addressed will respond by writing a brief description of the cause and corrective action required in the appropriate area on the CAR, sign and date the response, and return the CAR to the QAO.

The Project Manager will be responsible for ensuring that all required corrective actions identified during an audit are acted upon promptly and satisfactorily. The QAO or a qualified designee will verify and document that satisfactory corrective action has been taken (Figure 8-2). All audit checklists; audit reports, audit findings, and acceptable resolutions will be approved by the QAO. Then the QAO will close the audit. The QAO will maintain a status log for CARs, and the CARs will be retained in the project file.

8.2 RECORD MAINTENANCE

A project file will be established to retain the documents and records generated during the project. Field records will be stored in the project file when not in use. At the conclusion of the work assignment the project file will be archived.

Field records that must be retained in the project files include:

- Field books and logs;
- Chain-of-Custody forms;
- Site photographs; and
- QA audit reports.

Equipment calibration and maintenance records will be retained by a designated Parsons equipment manager for at least as long as the project files are retained.

FIGURES

Figure 8-1
Corrective Action Request Form
Quanta Resources Site
Edgewater, New Jersey

Name of Requestor:			
CAR Number:		Date:	
Follow up by (Name):			
Problem identified:			
Date by which problem must be resolved:			
Action agreed:			
Task Manager Signature:		Date:	
QA Manager Signature:		Date:	
Project Manager Signature:		Date:	

Figure 8-2
Corrective Action Request Disposition Form
Quanta Resources Site
Edgewater, New Jersey

Name of Requestor:			
CAR Number:		**Date:**	
Follow up by (Name):			
Problem identified:			
Date by which problem must be resolved:			
Action agreed:			
Corrective action taken:			
Task Manager Signature:		**Date:**	
QA Manager Signature:		**Date:**	
Project Manager Signature:		**Date:**	

SECTION 9
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ATTACHMENT A

USEPA REGION II
GROUNDWATER SAMPLING SOP

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II

GROUND WATER SAMPLING PROCEDURE
LOW STRESS (Low Flow) PURGING AND SAMPLING

I. SCOPE & APPLICATION

This Low Stress (or Low-Flow) Purging and Sampling Procedure is the EPA Region II standard method for collecting low stress (low flow) ground water samples from monitoring wells. Low stress Purging and Sampling results in collection of ground water samples from monitoring wells that are representative of ground water conditions in the geological formation. This is accomplished by minimizing stress on the geological formation and minimizing disturbance of sediment that has collected in the well. The procedure applies to monitoring wells that have an inner casing with a diameter of 2.0 inches or greater, and maximum screened intervals of ten feet unless multiple intervals are sampled. The procedure is appropriate for collection of ground water samples that will be analyzed for volatile and semi-volatile organic compounds (VOCs and SVOCs), pesticides, polychlorinated biphenyls (PCBs), metals, and microbiological and other contaminants in association with all EPA programs.

This procedure does not address the collection of light or dense non- aqueous phase liquids (LNAPL or DNAPL) samples, and should be used for aqueous samples only. For sampling NAPLs, the reader is referred to the following EPA publications: DNAPL Site Evaluation (Cohen & Mercer, 1993) and the RCRA Ground-Water Monitoring: Draft Technical Guidance (EPA/530-R-93-001), and references therein.

II. METHOD SUMMARY

The purpose of the low stress purging and sampling procedure is to collect ground water samples from monitoring wells that are representative of ground water conditions in the geological formation. This is accomplished by setting the intake velocity of the sampling pump to a flow rate that limits drawdown inside the well casing.

Sampling at the prescribed (low) flow rate has three primary benefits. First, it minimizes disturbance of sediment in the bottom of the well, thereby producing a sample with low turbidity (i.e., low concentration of suspended particles). Typically, this saves time and analytical costs by eliminating the need for collecting and analyzing an additional filtered sample from the same well. Second, this procedure minimizes aeration of the ground water during sample collection, which improves the sample quality for VOC analysis. Third, in most cases the procedure significantly reduces the volume of ground water purged from a well and the costs associated with its proper treatment and disposal.

III. ADDRESSING POTENTIAL PROBLEMS

Problems that may be encountered using this technique include a) difficulty in sampling wells with insufficient yield; b) failure of one or more key indicator parameters to stabilize; c) cascading of water and/or formation of air bubbles in the tubing; and d) cross-contamination between wells.

Insufficient Yield

Wells with insufficient yield (i.e., low recharge rate of the well) may dewater during purging. Care should be taken to avoid loss of pressure in the tubing line due to dewatering of the well below the level of the pump's intake. Purging should be interrupted before the water level in the well drops below the top of the pump, as this may induce cascading of the sand pack. Pumping the well dry should therefore be avoided to the extent possible in all cases. Sampling should commence as soon as the volume in the well has recovered sufficiently to allow collection of samples. Alternatively, ground water samples may be obtained with techniques designed for the unsaturated zone, such as lysimeters.

Failure to Stabilize Key Indicator Parameters

If one or more key indicator parameters fails to stabilize after 4 hours, one of four options should be considered: a) continue purging in an attempt to achieve stabilization; b) discontinue purging, do not collect samples, and document attempts to reach stabilization in the log book; c) discontinue purging, collect samples, and document attempts to reach stabilization in the log book; or d) Secure the well, purge and collect samples the next day (preferred). The key indicator parameter for samples to be analyzed for VOCs is dissolved oxygen. The key indicator parameter for all other samples is turbidity.

Cascading

To prevent cascading and/or air bubble formation in the tubing, care should be taken to ensure that the flow rate is sufficient to maintain pump suction. Minimize the length and diameter of tubing (i.e., 1/4 or 3/8 inch ID) to ensure that the tubing remains filled with ground water during sampling.

Cross-Contamination

To prevent cross-contamination between wells, it is strongly recommended that dedicated, in-place pumps be used. As an alternative, the potential for cross-contamination can be reduced by performing the more thorough "daily" decontamination procedures between sampling of each well in addition to the start of each sampling day (see Section VII, below).

Equipment Failure

Adequate equipment should be on-hand so that equipment failures do not adversely impact sampling activities.

IV. PLANNING DOCUMENTATION AND EQUIPMENT

Approved site-specific Field Sampling Plan/Quality Assurance Project Plan (QAPP). This plan must specify the type of pump and other equipment to be used. The QAPP must also specify the depth to which the pump intake should be lowered in each well. Generally, the target depth will correspond to the mid-point of the most permeable zone in the screened interval. Borehole geologic and geophysical logs can be used to help select the most permeable zone. However, in some cases, other criteria may be used to select the target depth for the pump intake. In all cases, the target depth must be approved by the EPA hydrogeologist or EPA project scientist.

- Well construction data, location map, field data from last sampling event.
- Polyethylene sheeting.
- Flame Ionization Detector (FID) and Photo Ionization Detector (PID).
- Adjustable rate, positive displacement ground water sampling pump (e.g., centrifugal or bladder pumps constructed of stainless steel or Teflon). A peristaltic pump may only be used for inorganic sample collection.
- Interface probe or equivalent device for determining the presence or absence of NAPL.

- Teflon or Teflon-lined polyethylene tubing to collect samples for organic analysis. Teflon or Teflon-lined polyethylene, PVC, Tygon or polyethylene tubing to collect samples for inorganic analysis. Sufficient tubing of the appropriate material must be available so that each well has dedicated tubing.
- Water level measuring device, minimum 0.01 foot accuracy, (electronic preferred for tracking water level drawdown during all pumping operations).
- Flow measurement supplies (e.g., graduated cylinder and stop watch or in-line flow meter).
- Power source (generator, nitrogen tank, etc.).
- Monitoring instruments for indicator parameters. Eh and dissolved oxygen must be monitored in-line using an instrument with a continuous readout display. Specific conductance, pH, and temperature may be monitored either in-line or using separate probes. A nephalometer is used to measure turbidity.
- Decontamination supplies (see Section VII, below).
- Logbook (see Section VIII, below).
- Sample bottles.
- Sample preservation supplies (as required by the analytical methods).
- Sample tags or labels, chain of custody.

V. SAMPLING PROCEDURES

Pre-Sampling Activities

1. Start at the well known or believed to have the least contaminated ground water and proceed systematically to the well with the most contaminated ground water. Check the well, the lock, and the locking cap for damage or evidence of tampering. Record observations.

2. Lay out sheet of polyethylene for placement of monitoring and sampling equipment.

3. Measure VOCs at the rim of the unopened well with a PID and FID instrument and record the reading in the field log book.

4. Remove well cap.

5. Measure VOCs at the rim of the opened well with a PID and an FID instrument and record the reading in the field log book.

6. If the well casing does not have a reference point (usually a V- cut or indelible mark in the well casing), make one. Note that the reference point should be surveyed for correction of ground water elevations to the mean geodesic datum (MSL).

7. Measure and record the depth to water (to 0.01 ft) in all wells to be sampled prior to purging. Care should be taken to minimize disturbance in the water column and dislodging of any particulate matter attached to the sides or settled at the bottom of the well.

8. If desired, measure and record the depth of any NAPLs using an interface probe. Care should be taken to minimize disturbance of any sediment that has accumulated at the bottom of the well. Record the observations in the log book. If LNAPLs and/or DNAPLs are detected, install the pump at this time, as described in step 9, below. Allow the well to sit for several days between the

measurement or sampling of any DNAPLs and the low-stress purging and sampling of the ground water.

Sampling Procedures

9. Install Pump: Slowly lower the pump, safety cable, tubing and electrical lines into the well to the depth specified for that well in the EPA-approved QAPP or a depth otherwise approved by the EPA hydrogeologist or EPA project scientist. The pump intake must be kept at least two (2) feet above the bottom of the well to prevent disturbance and resuspension of any sediment or NAPL present in the bottom of the well. Record the depth to which the pump is lowered.

10. Measure Water Level: Before starting the pump, measure the water level again with the pump in the well. Leave the water level measuring device in the well.

11. Purge Well: Start pumping the well at 200 to 500 milliliters per minute (ml/min). The water level should be monitored approximately every five minutes. Ideally, a steady flow rate should be maintained that results in a stabilized water level (drawdown of 0.3 ft or less). Pumping rates should, if needed, be reduced to the minimum capabilities of the pump to ensure stabilization of the water level. As noted above, care should be taken to maintain pump suction and to avoid entrainment of air in the tubing. Record each adjustment made to the pumping rate and the water level measured immediately after each adjustment.

12. Monitor Indicator Parameters: During purging of the well, monitor and record the field indicator parameters (turbidity, temperature, specific conductance, pH, Eh, and DO) approximately every five minutes. The well is considered stabilized and ready for sample collection when the indicator parameters have stabilized for three consecutive readings as follows (Puls and Barcelona, 1996):

    +0.1 for pH
    +3% for specific conductance (conductivity)
    +10 mv for redox potential
    +10% for DO and turbidity

    Dissolved oxygen and turbidity usually require the longest time to achieve stabilization. The pump must not be removed from the well between purging and sampling.

13. Collect Samples: Collect samples at a flow rate between 100 and 250 ml/min and such that drawdown of the water level within the well does not exceed the maximum allowable drawdown of 0.3 ft. VOC samples must be collected first and directly into sample containers. All sample containers should be filled with minimal turbulence by allowing the ground water to flow from the tubing gently down the inside of the container.

    Ground water samples to be analyzed for volatile organic compounds (VOCs) require pH adjustment. The appropriate EPA Program Guidance should be consulted to determine whether pH adjustment is necessary. If pH adjustment is necessary for VOC sample preservation, the amount of acid to be added to each sample vial prior to sampling should be determined, drop by drop, on a separate and equal volume of water (e.g., 40 ml). Ground water purged from the well prior to sampling can be used for this purpose.

14. Remove Pump and Tubing: After collection of the samples, the tubing, unless permanently

installed, must be properly discarded or dedicated to the well for resampling by hanging the tubing inside the well.

15. Measure and record well depth.

16. Close and lock the well.

VI. FIELD QUALITY CONTROL SAMPLES

Quality control samples must be collected to determine if sample collection and handling procedures have adversely affected the quality of the ground water samples. The appropriate EPA Program Guidance should be consulted in preparing the field QC sample requirements of the site-specific QAPP. All field quality control samples must be prepared exactly as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples should be collected during the sampling event:

- Field duplicates
- Trip blanks for VOCs only
- Equipment blank (not necessary if equipment is dedicated to the well)

As noted above, ground water samples should be collected systematically from wells with the lowest level of contamination through to wells with highest level of contamination. The equipment blank should be collected after sampling from the most contaminated well.

VII. DECONTAMINATION

Non-disposable sampling equipment, including the pump and support cable and electrical wires which contact the sample, must be decontaminated thoroughly each day before use ("daily decon") and after each well is sampled ("between-well decon"). Dedicated, in-place pumps and tubing must be thoroughly decontaminated using "daily decon" procedures (see #17, below) prior to their initial use. For centrifugal pumps, it is strongly recommended that non-disposable sampling equipment, including the pump and support cable and electrical wires in contact with the sample, be decontaminated thoroughly each day before use ("daily decon"). EPA's field experience indicates that the life of centrifugal pumps may be extended by removing entrained grit. This also permits inspection and replacement of the cooling water in centrifugal pumps. All non-dedicated sampling equipment (pumps, tubing, etc.) must be decontaminated after each well is sampled ("between-well decon," see #18 below).

17. Daily Decon

    A) Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.
    B) Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Alconox, for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.
    C) Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.
    D) Disassemble pump.
    E) Wash pump parts: Place the disassembled parts of the pump into a deep basin containing 8 to 10 gallons of non-phosphate detergent solution. Scrub all pump parts with a test tube brush.

F) Rinse pump parts with potable water.
G) Rinse the following pump parts with distilled/ deionized water: inlet screen, the shaft, the suction interconnector, the motor lead assembly, and the stator housing.
H) Place impeller assembly in a large glass beaker and rinse with 1% nitric acid (HNO3).
I) Rinse impeller assembly with potable water.
J) Place impeller assembly in a large glass bleaker and rinse with isopropanol.
K) Rinse impeller assembly with distilled/deionized water.

18. Between-Well Decon

A) Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.
B) Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Alconox, for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.
C) Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.
D) Final Rinse: Operate pump in a deep basin of distilled/deionized water to pump out 1 to 2 gallons of this final rinse water.

VIII. FIELD LOG BOOK

A field log book must be kept each time ground water monitoring activities are conducted in the field. The field log book should document the following:

- Well identification number and physical condition.
- Well depth, and measurement technique.
- Static water level depth, date, time, and measurement technique.
- Presence and thickness of immiscible liquid layers and detection method.
- Collection method for immiscible liquid layers.
- Pumping rate, drawdown, indicator parameters values, and clock time, at three to five minute intervals; calculate or measure total volume pumped.
- Well sampling sequence and time of sample collection.
- Types of sample bottles used and sample identification numbers.
- Preservatives used.
- Parameters requested for analysis.
- Field observations of sampling event.
- Name of sample collector(s).
- Weather conditions.
- QA/QC data for field instruments.

IX. REFERENCES

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